

Master's Thesis of Thomas Merrath

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As the importance of cycling in traffic increases the need to capture more data on bicycle traffic state grows. Therefore, the aim of this thesis is to adapt a methodology, developed by Bertsimas et al. (2019)¹, onto the use for cycling traffic. They observed motorized traffic flows by using taxi data in New York. The input data for this study are origin destination pairs from trips with Munich's most used shared bike service, the MVG Rad. To route the trips an open street map-based graph of the city's street grid is created, and all trips are routed onto that graph. Via the analysis of all trips, which pass certain control points, the trips' mean speeds were compared. Figure 1 shows a cutout of the graph around the control point on *Luitpoldbrücke*. Each trip needs to pass one of the highlighted links to be counted as passing the bridge.

The analysis shows that the methodology is able to show known delays, such as higher speeds when cycling uphill than when cycling downhill. Figure 2 demonstrates this trend for

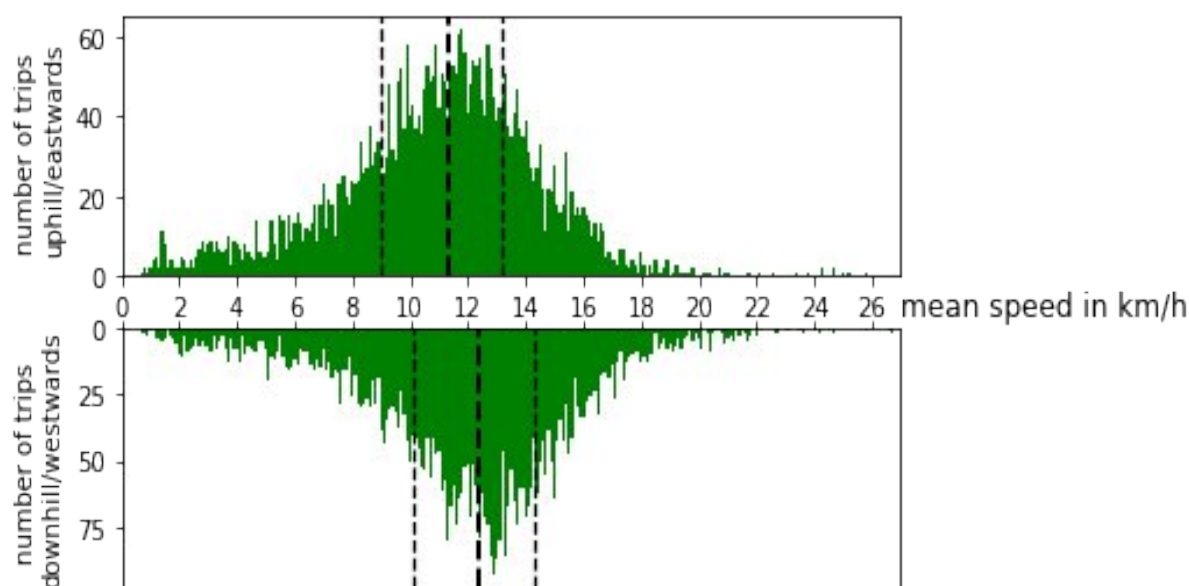


Figure 2: The trips passing Luitpoldbrücke eastward/uphill are significantly slower than the trips westward



Figure 1: A cutout of the graph, with all links passing Luitpoldbrücke highlighted.

trips passing *Luitpoldbrücke*. Additionally, clear patterns in user behaviour can be seen with faster trips in the morning, than in the afternoon and evening hours (figure 3). But when going into traffic state analysis and taking a look at more fragile effects, it shows that the methodology is not capable of finding such effects in the data. The study then discusses possible improvements on the methodology, such as including more diversified route choice instead of the shortest path, which was used for this analysis.

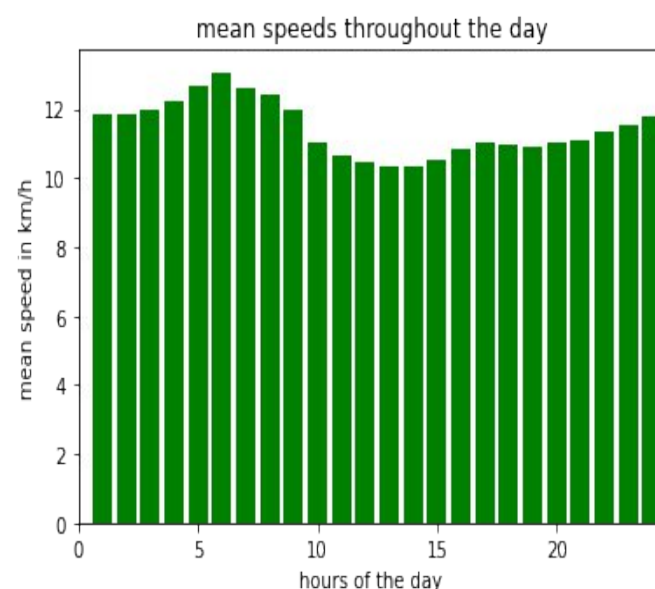


Figure 3: The highest mean speeds occur around 6 am, the lowest from noon to afternoon.

1: Bertsimas, D., Delarue, A., Jaillet, P., & Martin, S. (2019). Travel Time Estimation in the Age of Big Data. *Operations Research*. Advance online publication. <https://doi.org/10.1287/opre.2018.1784>